DATE: 06 July 2001

TO: Mr. Thomas Budroe, U.S. EPA/RST On Scene Coordinator

THROUGH: Paul Potvin, RST Task Leader

FROM: John Williams, WESTON

SUBJECT: GEOPHYSICAL INVESTIGATION, BCF OIL TANK FARM AREA, BROOKLYN, NEW YORK, GEOPHYSICAL FIELD SUMMARY

INTRODUCTION

A Geophysical survey was performed at the BCF Refining Facility, in Brooklyn, New York on 02 July 2001. The survey concentrated around the four 110,000 gallon oil storage tanks (tank farm) located on the south side of the site. A compliment of geophysical methods, including Time-Domain Electromagnetic (TDEM) Imaging (EM-61) and Ground Penetrating Radar (GPR) were used to investigate appurtenances of unknown origin; specifically four stand-pipes, two suspected fill pipes, a suspected concrete sump and four pipes exposed during excavation activities on the east side of the tank farm.

This report presents a description of the investigation, applied geophysical techniques, and a review of the data collected by WESTON during the survey. A TDEM contour plot and two representative GPR cross-sectional profiles are shown in Figures 1, 2, and 3, respectively.

SURVEY IMPLEMENTATION

Geophysical Survey Grid

Prior to conducting the survey, a reference grid was established to provide a means of surface control during the TDEM and GPR data collection. The survey grid was established on a relative coordinate system using the southeast corner of the containment walls as the origin. A Trimble PRO XRS Differential Global Positioning System (DGPS) was used to geo-reference existing structures (containment walls, tanks, and pipes) along with the geophysical field data obtained at the site. All data is referenced to the NAD83/UTM zone 18N grid coordinate system.

Time Domain Electromagnetic (TDEM) Survey

The TDEM survey was conducted using a Geonics, Ltd. EM-61-Hand Held (HH)™ metal detector. In general, the instrument measures a radiated signal from a conductive object after a transmitted pulse has been induced. Output from the three channels (Early, Late and Decay Time) provides information regarding the location and relative size of buried metal conductive objects. Prior to conducting the surveys, the instrument was calibrated in accordance with the instrument-operating manual.

The EM-61-HH survey was performed along pre-established grid lines (transects) using 2.5-foot line spacing. The maximum depth of penetration for this instrument is approximately 7 feet for a bulk metallic object (i.e., an UST). Measurements were digitally recorded and stored in memory in a data logger at approximate .5-foot intervals as the operator traversed each line. The data in memory were downloaded from the data logger to a field computer and conductivity contour plots for both the early and late channels were generated in the field. The data were interpreted on site with two goals; 1.) to identify any significant TDEM anomalies associated with the four stand-pipes, two suspected fill pipes, a suspected concrete sump and four pipes exposed during excavation and 2.) to identify specific areas to focus on with the GPR.

Ground Penetrating Radar (GPR) Survey

The GPR survey was conducted using a Geophysical Surveys Systems, Inc. Subsurface Interface Radar™ (SIR) System 10A+ model. The GPR consists of a control/display unit, mainframe/data storage unit, microcomputer, and 500-megahertz (MHz) antenna. The GPR automatically records and displays cross-sectional profiles of the subsurface. Depth of penetration is site-specific and is dependent upon the electrical characteristics of the site materials and the frequency of the transmitter; therefore a site-specific calibration was conducted accordance with the instrument-operating manual. The depth of penetration was limited to about approximately 8 feet.

The GPR was field-calibrated using an averaged dielectric constant for the survey medium. Surveying was accomplished by traversing the specific areas of interest, including the four stand-pipes, two suspected fill pipes, a suspected concrete sump and four exposed pipes. A 500 MHz antenna was used to scan the subsurface along specified lines to better characterize the suspected feature. The product of the GPR survey was a series of real-time subsurface field profiles. Two of these profiles are shown in Figures 2 and 3.

RESULTS

EM anomalies for both the early and late channels were composited onto the late channel contour plot (shown in Figure 1). Interpretations were made with regard to the suspected features and characteristics of the detected anomaly. “Background” appears on the low end of the response color bar (shown in green). In contrast, anomalies generated by conductive metallic objects in the subsurface appear as high positive EM responses (shown in violet). Pipes appear as linear features while bulk objects appear diffuse. Three significant anomalies were identified and are discussed below:

- Anomaly A - Anomaly A is located to the north of Tank 13/17, approximately 10 feet from the northern containment wall. The amplitude of the EM response associated with Anomaly A is between 2000 and 4000mV above background. The geometry of the source is elongated in the east-west direction and the EM gradient extends approximately four to six feet horizontally. The anomaly is located immediately adjacent to a port, measuring

approximately 3 inches in diameter and flush-mounted at the ground surface. The cross-sectional radar profile for Anomaly A is shown in Figure 2. Although there was a distinct radar signature possessing the characteristics of a buried pipe*, there was no indication (on the GPR profile) of a UST like feature in this area*.

- Anomaly B - Anomaly B is located in northeast corner of Tank 12's containment area, approximately 8 feet from the north wall. The amplitude of the TDEM response associated with Anomaly B is between 1500 and 3000mV above background. The geometry of the source is diffuse in the east-west direction and the EM gradient extends approximately four to six feet horizontally. The anomaly is located immediately adjacent a port, measuring approximately 3 inches in diameter and about one foot above the ground surface. The cross-sectional radar profile for Anomaly B (shown in Figure 3) reveals a high amplitude, hyperbolic reflection. Based on the vertical depth scale, (which was calculated using a dielectric constant for average loamy soils) the signature occurs between 4.5-feet (ft) to 5.5 ft below ground surface (BGS). *The signature characteristics of Anomaly B suggest a moderate potential for representing a metallic UST at this location*. Based on the geometry and extent of the EM and radar signatures the size is approximately consistent with a 500 +/- gallon UST.

- Anomaly C - Anomaly C is located approximately five feet north of the intersection of the inner walls. The amplitude of the EM response associated with Anomaly C is greater than 4000mV above background. *Due to the presence of numerous surface pipes and related features in this area, it cannot be ascertained whether this anomaly is of surface or subsurface origin*.

- General observations:
  - The GPR cross-sectional profiles consistently exhibit a high amplitude, horizontal reflective layer between 5.5 and 6.5-feet BGS. This layer occurs as a result of strong dielectric changes in the shallow materials, most likely related to a conductive groundwater layer.
  - The geophysical data did not indicate the presence of USTs below any of the four stand-pipes.
  - Numerous pipes (above and below ground surface) are shown on Figure 1. The geophysical data indicates that the four pipes exposed on the east side of the containment area (during excavation activities) either terminate approximately 10 feet from the east wall or turn 90 degrees and continue toward the northern wall.

We appreciate this opportunity to offer our services to Response Support Team on this important project. If you require additional information please do not hesitate to contact John Williams at (610) 701-7256 or Rob Jacob at (610) 701-5219.

Very truly yours,

ROY F. WESTON, INC.

John A Williams, Jr., PG
Technical Manager

Enclosure

EM-61 PLOT
And
GPR PROFILES
BCF OIL
MASPETH AVENUE
BROOKLYN, NY
JULY 2001

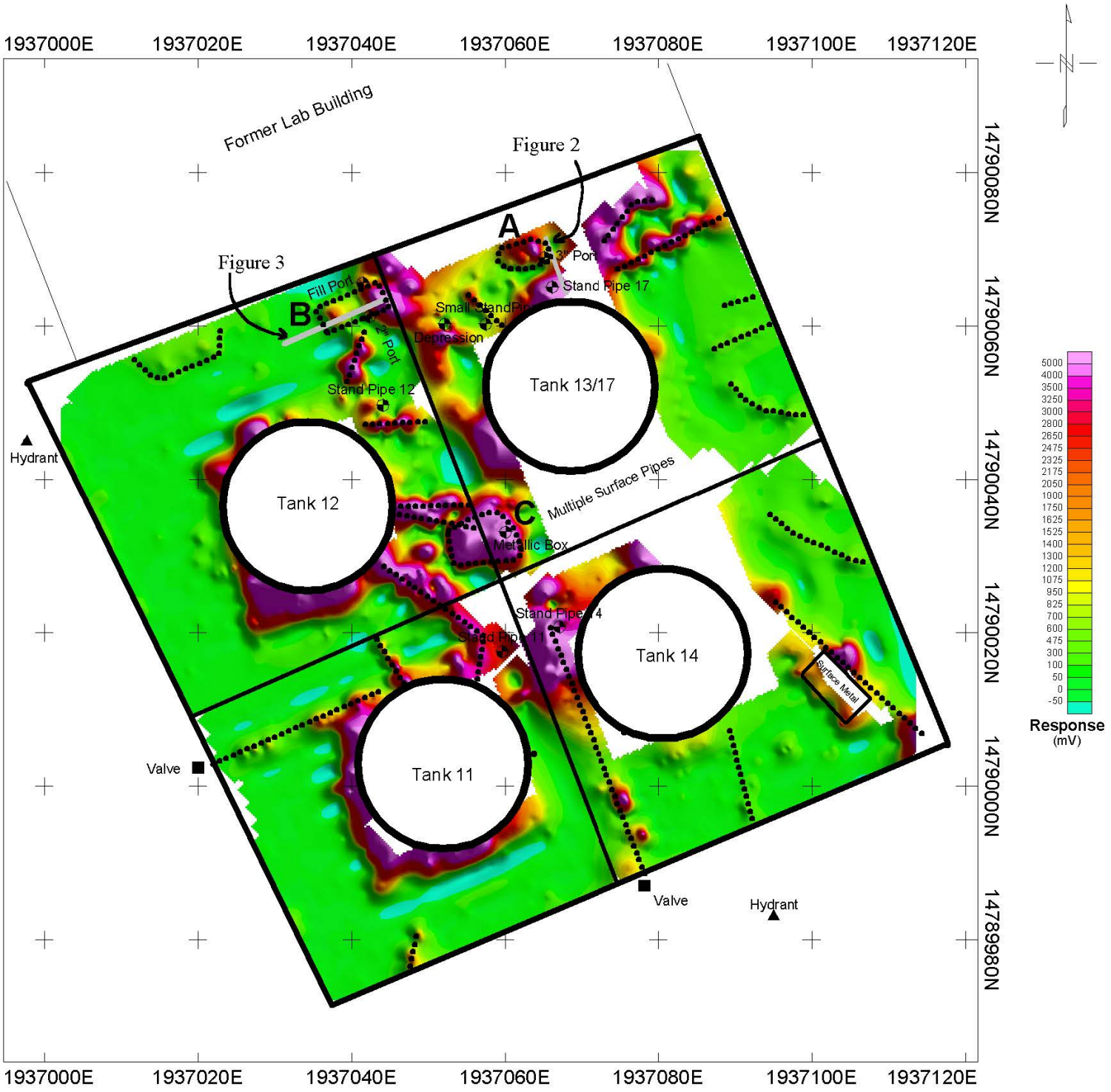


Figure 1

LEGEND

Pipe / Anomaly (A,B, &C)

Represenative GPR Cross-Sectional Profiles In Respective Figure

Scale 1:240

10 0 10

US survey foot

NAD83 / UTM zone 18N

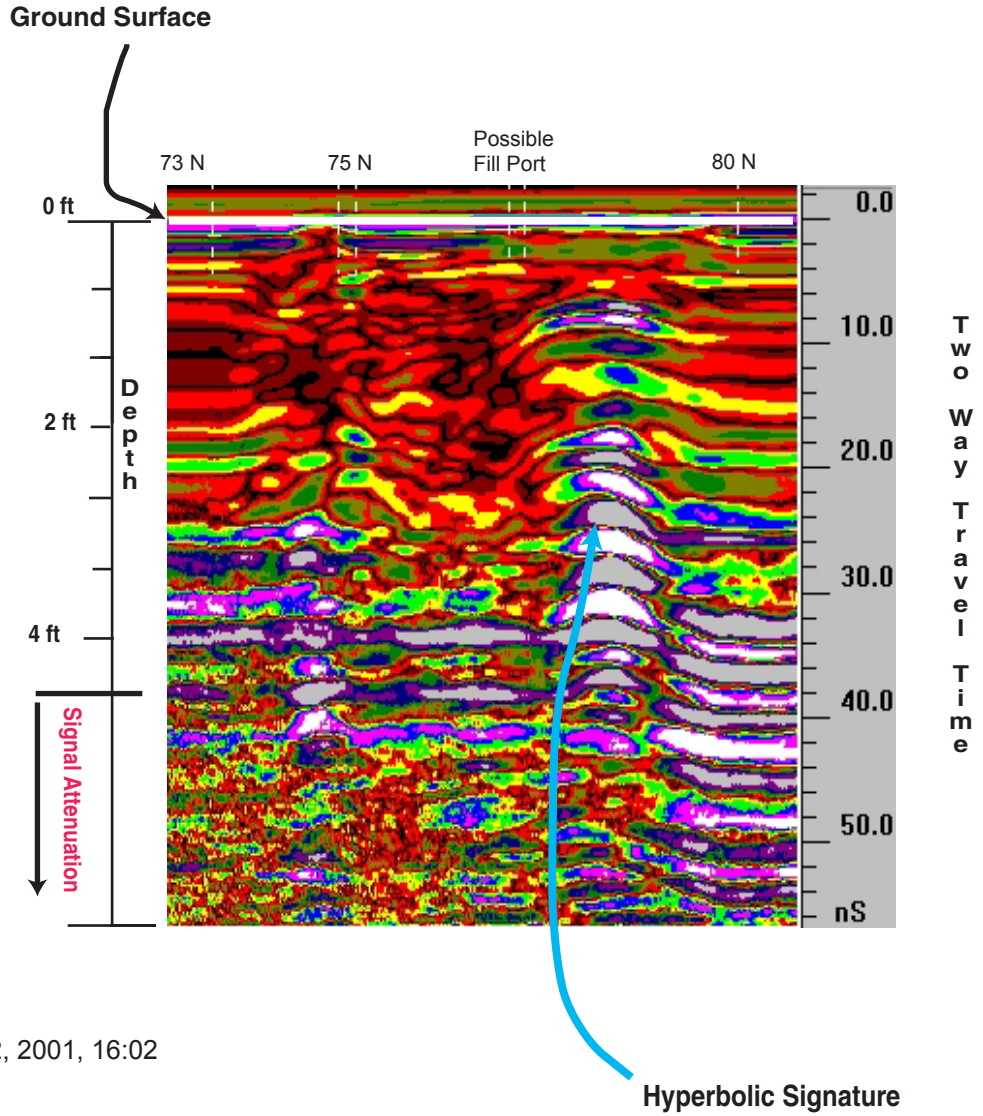
RST / EPA Region II

BCF Oil
362 Maspeth Ave
Brooklyn, NY

TDEM Survey (EM-61-HH)
Late Channel

Roy F. Weston, Inc.

United States Environmental Protection Agency Region II - RST Contract
BCF Oil Site (362 Maspeth Ave, Brooklyn, NY) - Storage Tank Containment Area

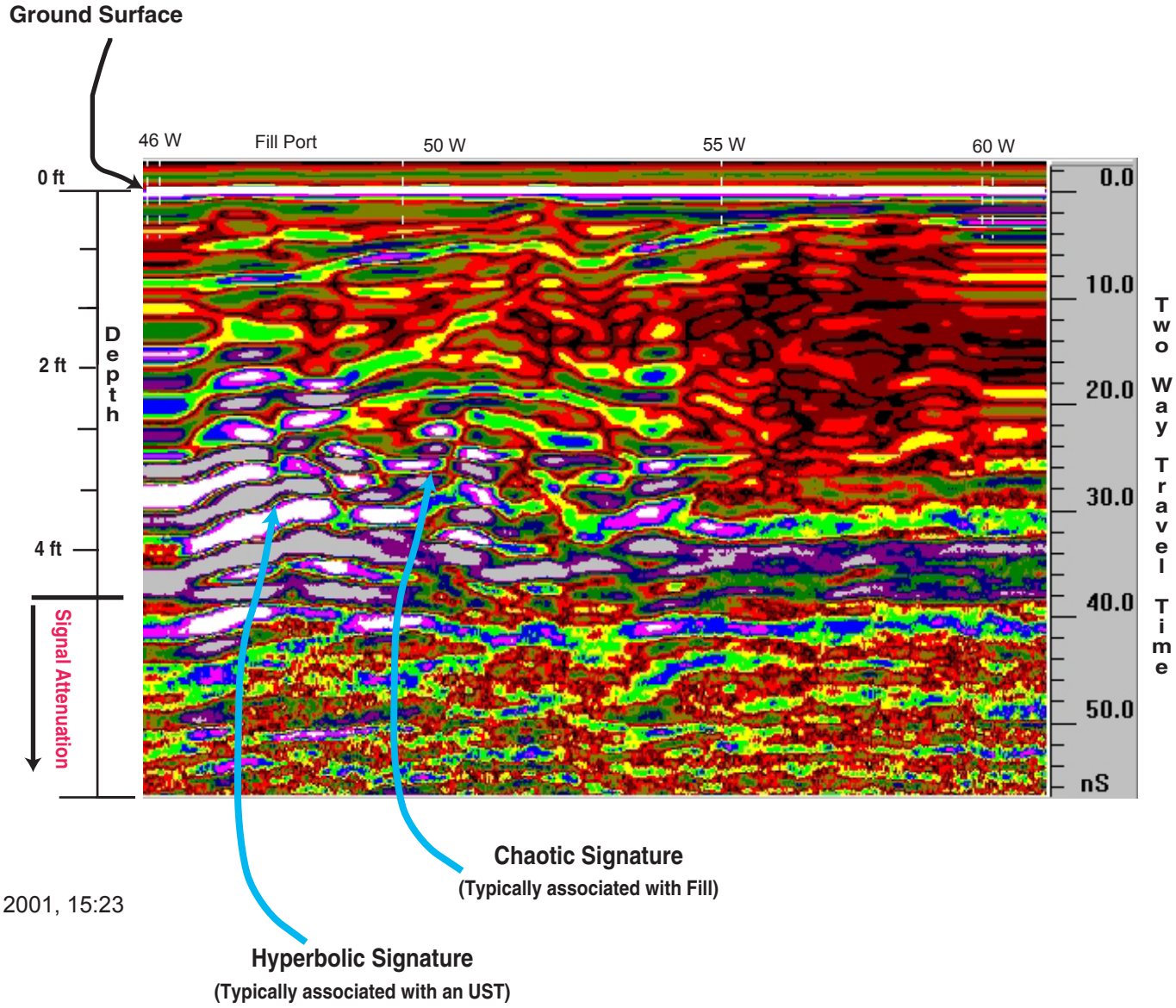


File 13: Created July 2, 2001, 16:02
Traverse: 22.5 West
Start: 73 North
Stop: 80 North

Geoscience2001 EPA / RST002 6/5/01

FIGURE 2 REPRESENTATIVE GPR PROFILE: ANOMALY A

United States Environmental Protection Agency Region II - RST Contract
BCF Oil Site (362 Maspeth Ave, Brooklyn, NY) - Storage Tank Containment Area



File 5: Created July 2, 2001, 15:23
Traverse: 83 North
Start: 46 West
Stop: 60 West

Geoscience2001 EPA / RST003 6/5/01

FIGURE 3 REPRESENTATIVE GPR PROFILE: ANOMALY B